REPORT
FOUNDATION INVESTIGATION
PROPOSED KAPOLEI NEIGHBORHOOD, UNIT 6

MAKAKILO, OAHU,
STATE OF HAWAII
TMK 9-1-16:17

for

FINANCE REALTY COMPANY, LTD.

SUNN, LOW, TOM & HARA
Civil Engineers

May 27, 1976
Project No. H-0073-F

SOILS INTERNATIONAL
Consulting Foundation Engineers & Geologists

SOILS INTERNATIONAL
A CORPORATION
Consulting Foundation Engineers and Geologists

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May 27, 1976
Project No. H-0073-F

Finance Realty Company, Ltd.
P. O. Box 3979
Honolulu, Hawaii 96813

Attention: Mr. Ranceford Yoshida

Gentlemen:

The attached report presents the data, conclusions and recommendations of an investigation of the soil conditions at the site of the proposed Kapolei Neighborhood, Unit 6 development to be located in Makakilo City, Honouliuli, Ewa, Oahu, Hawaii, Tax Map Key, 9-1-16:17.

The scope of services provided in this investigation was planned to coincide with requirements of the Federal Housing Administration.

Based on the findings of this investigation, no soil or geologic conditions were encountered which would preclude the planned site development, provided the recommendations contained herein are included in the design and construction of the project. Spread footings may be used for support of the single-family residences.

This investigation was made in accordance with generally accepted engineering procedures and included such field and laboratory tests considered necessary for the project. In the opinion of the undersigned, the accompanying report has been substantiated by mathematical data in conformity with generally accepted engineering principles and presents fairly the design information requested by your organization. No other warranty is either implied or given.

Respectfullysubmitted,

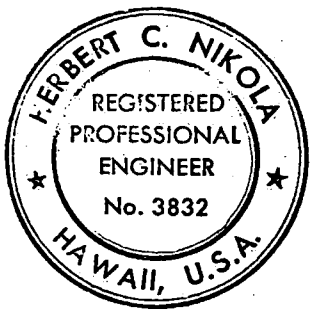
SOILS INTERNATIONAL

Lawrence S. Shinsato

LSS:HCN:rlk

Lawrence S. Shinsato

This work was performed by me or under my supervision.



Herbert C. Nikola,
Hawaii Division Manager

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INTRODUCTION

This investigation was made for the purpose of obtaining information on the soils on which to base recommendations for suitable site development and foundation design for the proposed Kapolei Neighborhood, Unit 6 development to be located in Makakilo City, Oahu, Hawaii. The location of the site, relative to the existing streets and landmarks, is shown on the Vicinity Map, Plate 1.

SCOPE OF WORK

The scope of services provided was outlinedin our proposal dated March 19, 1976. Basically, the information provided is as follows:

1. General subsurface conditions of the site, as disclosed by the test pits.
2. Engineering characteristics of the soils encountered.
3. Recommended foundation design criteria for shallow foundations for support of single-family residential structures.
4. Recommendations for site preparation and grading.
5. Special considerations.

PLANNED DEVELOPMENT

The planned development is a 17.2 acre site located in lower Makakilo City with access from Uhiuala and Akaawa Streets. The development will include 100 lots for proposed single family dwellings with remnant Lot 101

intended for future use. The houses will be of wood construction using either slab-on-grade or isolated post foundations.

Maximum fills of eight (8) feet are anticipated.

SITE CONDITIONS

Surface

The site is presently covered by a dense growth of brush and vegetation, with a dense growth of keawe trees along the southeast boundary.

Numerous boulders up to six (6) feet in diameter are scattered over the site.

The site is bounded on the northeast by existing single-family homes, on the west by the Puu Palailai cinder cone and on the southwest by an abandoned quarry.

From plans provided by others, surface elevations range from +300 feet at the northwest to +200 feet at the southeast.

Subsurface

The subsurface conditions at the site were explored by means of 42 test pits up to seven (7) feet in depth.

In general, the test pits revealed red-brown and dark-brown silt and clay mixtures, overlain and also interspeced with boulders. The soils are moderately firm to very firm in consistency and moderately moist to moist. There are a few isolated areas of slightly moist, loose soils.

The silty clays (CL/ML by the Unified Soil Classification System), were found from our laboratory tests, to be moderately expansive. This means they expand between two (2) to six (6) percent in going from air dry to saturation moisture content under a surcharge of one (1) psi.

The clays (CL, CH, CH/MH and CL/CH by the Unified Soil Classification System), were found, from our laboratory tests, to be very highly expansive. This means they expand more than ten (10) percent in going from air dry to saturation moisture content under a surcharge of one (1) psi.

A nested boulder area, possibly old fill, approximately two (2) to three (3) feet thick, was found in the area of Test Pits 13 and 14. The approximate extent of this area is shown on the Plot Plan, Plate 2.

No groundwater was encountered in any of the test pits at the time of this investigation.

Detailed logs of the test pits are presented in Appendix A, and their locations are shown on the Plot Plan, Plate 2.

CONCLUSIONS AND RECOMMENDATIONS

General

In developing the site for the proposed single-family homes, special consideration should be given to the expansive soils, removal and/or disposal of the on-site boulders and recompaction of slightly to moderately compressible soils.

The site should be prepared in accordance with the "Specification For Controlled Earthwork", Appendix B.

Where fill, and/or low density natural soils are present, they shall be removed and/or recompacted in accordance with the above mentioned specifications. Provisions shall be made to protect the foundation soils from moisture infiltration by proper exterior grading.

Foundations

Slab-on-grade foundations appear more suitable for the areas of moderately expansive soils, where bedrock is exposed at or near the surface or where non to moderately expansive, compacted fill, a minimum of three (3) feet thick is present on the lot.

The moderately expansive soils were encountered in the southeasterly section of the site in the vicinity of Lots 55 through 67 and 80 through 90 (See Plot Plan for lot numbers).

A maximum allowable bearing value of 2500 pounds per square foot is recommended for exterior footings at twelve (12) inches below the lowest adjacent grade. Interior footings may be embedded eight (8) inches below top of slab for floor slabs-on-grade poured integrally with the footings. This recommendation also applies for all lots with three (3) feet or more of non to moderately expansive, compacted fill over more expansive soil. If post and beam footings are used, the same minimum embedment recommendations apply.

Footings bearing on the underlying basalt bedrock may be designed for an allowable bearing value of 6000 pounds per square foot.

Where bedrock is encountered within twelve (12) inches of finished lot grade, exterior footings shall be embedded a minimum of twelve (12) inches below the lowest exterior grade. Interior footings need only bear firmly in the bedrock with no minimum embedment required. This applies for slab-on-grade and post and beam foundations.

Raised floors supported on a deepened post and beam system appear to be the more suitable foundation for the areas of very highly expansive soil. The very highly expansive soils were found on most of the remaining lots. A maximum allowable bearing value of 2500 pounds per square foot may be used for pier and post foundations deepened to at least three (3) feet below finished grade. In lieu of deepening the foundation, the footing may be excavated to bedrock and then backfilled to bottom of footing with compacted rock base. If this is done, the minimum embedment is twelve (12) inches.

Footings adjacent to the top of fill or cut slopes shall be deepened, if required, so that the bottom of the footing is at a minimum horizontal distance of five (5) feet from the face of the slope to provide lateral support.

The bearing values presented in this report are net bearing values and the weight of the concrete foundation, below the lowest adjacent grade may be

ignored in determining the foundation loads. The bearing values may be increased by one-third (1/3) for momentary loads due to wind or seismic forces. If any foundation is eccentrically loaded, the maximum edge pressure shall not exceed the bearing pressure for permanent or for momentary loads.

Settlement of footings up to two (2) feet wide or four (4) feet square, and bearing on properly prepared soil are not expected to exceed one-half(1/2) inch under the fully applied recommended loads. Settlement of footings bearing on basalt should be negligible.

Should footings bear upon both basalt and soil, differential settlements of up to one-half (1/2) inch may occur. This condition should be considered in the design of the foundations.

Lateral Resistance

An allowable passive resistance equivalent to that exerted by a fluid weighing 300 pounds per cubic foot may be used for footings, or other structural elements, provided the vertical surface is in direct contact with the undisturbed, natural or compacted soil. Friction between footings or slabs and the underlying soil may be assumed as 0.4 times the dead load. Lateral resistance and friction may be combined provided the assumed lateral resistance does not exceed two-thirds (2/3) of the allowable. Lateral resistance for footings embedded at least six (6) inches in the basalt may be assumed as 4000 pounds per square foot.

Retaining Walls

Small retaining walls, five (5) feet or less in height, with level, properly draining backfill, should be designed to resist an equivalent fluid pressure of thirty (30) pounds per cubic foot if granular backfill is used, and forty (40) pounds per cubic foot if the moderately expansive, on-site clays and silts are used. If the very highly expansive soils are used for backfill, a one (1) foot wide granular cushion should be placed adjacent to the wall and extend from the base of the footing to one (1) foot from finished grade. Using the cushion and providing positive drainage, an equivalent fluid pressure of forty (40) pounds per cubic foot may be used.

The recommended allowable bearing pressures and lateral resistance for retaining walls are the same as those previously recommended for building foundations.

Slopes

Fill slopes with maximum inclination of 2 horizontal to 1 vertical, is recommended. Slopes of 1/2 to 1, 1 to 1, and 2 to 1 (horizontal to vertical), are recommended for cuts made into massive rock, decomposed rock and in-place soils, respectively.

The relatively shallow drainage diversion swale, which will have a maximum depth on the order of three (3) feet can be constructed with side slopes of 1-1/2 horizontal to 1 vertical. Cut slopes in natural soil, up to a maximum height of five (5) feet can be made at 1-1/2 to 1. According to

Taylor's Stability charts, soils having an angle of friction of 10° or more and a cohesion of 150 pounds per square foot or more, have a factor of safety greater than three (3) for slope heights up to five (5) feet at 1-1/2 horizontal to 1 vertical. The soils on the site exceed the required minimum strength characteristics under saturated conditions (See Appendix A). All slopes in soil higher than five (5) feet shall be made at 2 horizontal to 1 vertical.

Excavations into the massive rock may require blasting.

Preparation of the site prior to construction of fill slopes shall be as described in the "Specifications For Controlled Earthwork", Appendix B.

Special Considerations

Expansive Soils

In the areas of moderately expansive soils, i.e., the southeasterly portion of the site in the vicinity of lots 55 through 67 and 80 through 90, depth of removal below slabs-on-grade shall be twenty-four (24) inches and replacement with non-expansive soils. As an alternate, the in-place moderately expansive soils could be presaturated to a moisture content of at least three (3) percent above the optimum moisture content to a depth of at least twenty-four (24) inches, prior to pouring the slab. Provisions shall be made in the design of the slab to prevent possible adverse effects from expansive soils.

Pre-saturation tests shall be made by the Soils Engineer to ascertain conditions before pouring the slabs.

On the remainder of the site, where soils with very high expansion characteristics are encountered, the soils under slabs shall be removed to a depth of at least thirty-six (36) inches below subgrade and replaced with non-expansive soil. Any rock used as a moisture barrier or "cushion" under the floor slabs may be considered as a part of this thiry-six (36) inch thickness.

Where post type foundations are used, the very highly expansive soils need not be removed. However, the footings shall be deepened to at least three (3) feet below finished grade (See page 5). Proper drainage shall be provided to prevent ponding around the foundations.

During construction should soils with expansion characteristics greater than those encountered be found, these recommendations shall be reviewed and if necessary, be modified by the Soils Engineer. Modification of the expansive characteristics of soils by chemical or mechanical means could also be considered if obtaining non-expansive soils is not considered to be a reasonable construction procedure.

Compressible Soil

Some of the existing red-brown silty clays are slightly to moderately compressible when exposed to moisture and subjected to loading. Should these and other compressible soils be found under building

areas, they shall be removed to firm material and recompacted. The material shall then be brought to optimum moisture and placed in accordance with the fill placement specifications of this report. Where expansive soils are removed, the aforementioned recommendations for handling these soils shall be followed.

Boulders

The boulders should be disposed of in accordance with the recommendations given in Appendix B, Fill Section.

Tree Roots

In the area containing the keawe trees, all large tree roots shall be removed and the resultant excavations brought to finished grade with compacted soil in accordance with Appendix B.

Site Drainage

Appropriate engineering design concepts should be implemented to handle the run-off of surface waters from outside of this development. Grading within the property could expose permeable strata or cut off established subsurface seepage paths. If this occurs, supplemental subsurface drainage may have to be provided. For minor seepage, a French type drain, two (2) to three (3) square feet of crushed rock or aggregate per lineal foot of trench, would be one method to provide the supplemental drainage. For moderately heavy seepage, a vee-shaped, or rectangular trench with six (6) to nine (9) square feet of

crushed rock or aggregate per lineal foot of trench with a four (4) inch diameter perforated pipe embedded in the rock, is one method that has proved satisfactory to control moderately heavy seepage of subsurface water. Final determination shall be made by the Soils Engineer.

INSPECTION

During the progress of construction, so as to achieve the desired results, it is recommended that the Soils Engineer be present to review the following operations:

1. Site preparation
2. Placement of fill and backfill
3. Treatment of expansive soils
4. Footing excavations.

REMARKS

The conclusions and recommendations contained herein are based on the findings and observations made at the test pit locations. If conditions are encountered during construction which appear to differ from those disclosed by the test pits, this office should be notified so as to consider the need for modifications.

No responsibility for construction compliance with the design concepts, specifications or recommendations is assumed unless on-site reivew by Soils International is performed during the course of construction which pertains to the specific areas covered by the recommendations contained herein.

This report has been compiled for the exclusive use of Finance Realty Company, Ltd. It shall not be used by or transferred to any other party or to another project without the consent and/or thorough review by this facility. Should the project be delayed beyond the period of one (1) year from the date of this report, the report shall be reviewed relative to possible changed conditions.

Samples obtained in this investigation will deteriorate with time and will be unsuitable for further laboratory testing within one (1) month from the date of this report. Unless otherwise advised, the samples will be discarded at that time.

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The following are included and complete this report:

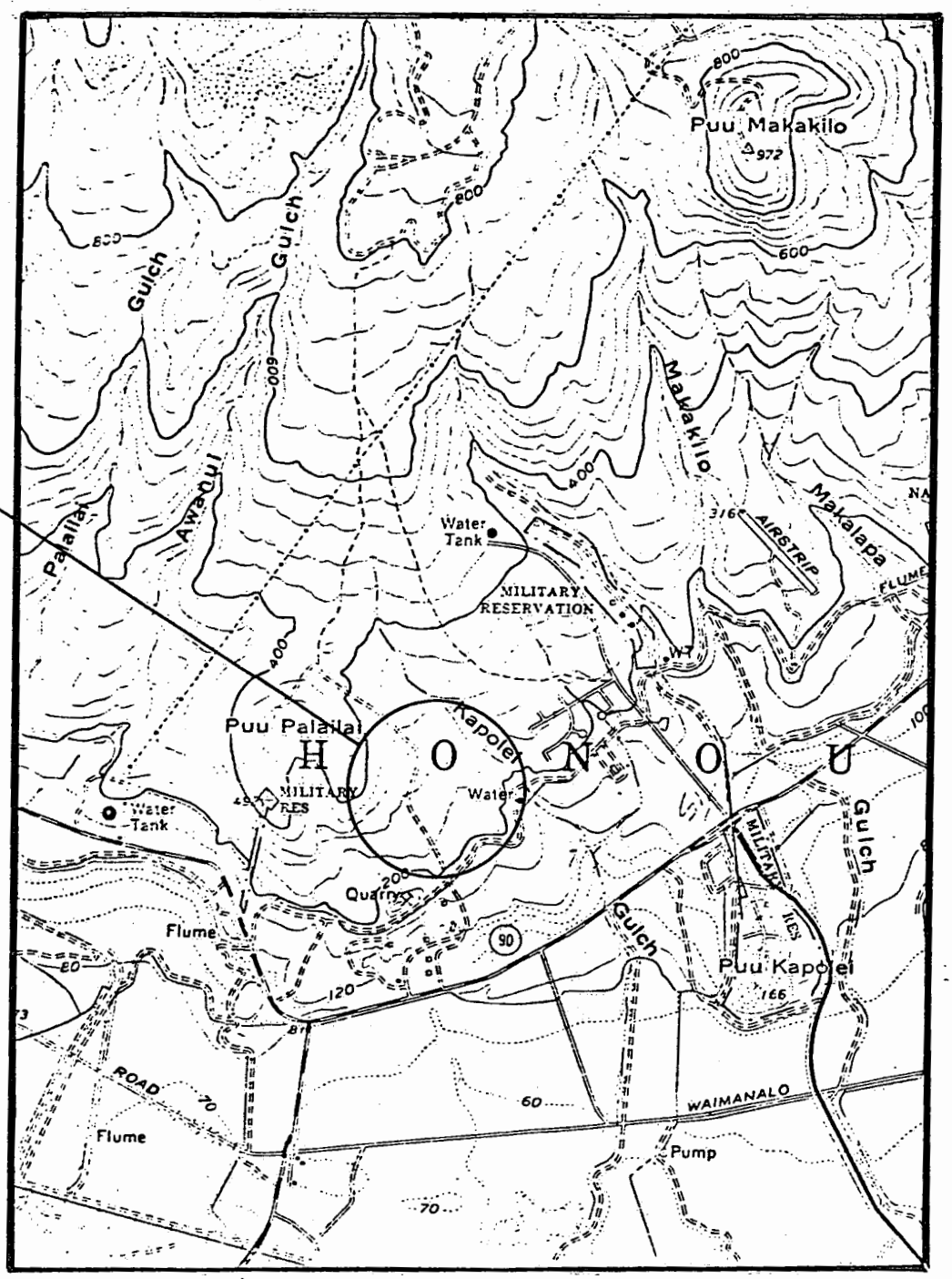
Plate 1 - Vicinity Map

Plate 2 - Plot Plan

Appendix A - Field Investigation and Laboratory Testing

Appendix B - Speicification For Controlled Earthwork

VICINITY MAP



REFERENCE

USGS Topographic Survey
Ewa, Oahu Quadrangle
Dated 1962

KAPOLEI NEIGHBORHOOD, UNIT 6	PLATE NO 1
SOILS INTERNATIONAL	FILE NO H-0073-F

APPENDIX A

FIELD INVESTIGATION AND LABORATORY TESTING

Field Investigation

Forty-two (42) test pits were excavated to depth of up to seven (7) feet. Detailed logs of the subsurface materials encountered are presented on Plates 3 through 10, and their locations are shown on the Plot Plan, Plate 2.

Soils samples of the major materials encountered that would influence site grading and foundation design were taken from the test pits. These samples were transported to the laboratory for examination and testing.

Laboratory Testing

Samples were selected for laboratory testing following a review of the information obtained during the field investigation. Tests performed included field unit weight and moisture content, sieve analysis, Atterberg limits, direct shear, maximum dry density and optimum moisture content, consolidation and expansion.

To determine the strength characteristics of the recompacted, natural soils, remolded samples of the representative soils were tested in the direct shear machine under increasing loads. This was done to develop Mohr's envelope for the establishment of the cohesion and angle of internal friction. The results are presented on Plate 11.

Remolded samples from Test Pit 5 were also tested for shear strength under saturated conditions. The results are as follows:

Load (Ksf)	Yield Shear Strength (Ksf)
0.50	0.39
1.00	0.50
1.50	0.62

Atterberg limit and sieve analysis tests were performed on representative samples for classification purposes, using the Unified Soil Classification System. The results are presented on Plate 11.

Consolidation tests were performed on representative, near surface samples. The test was performed on a one (1) inch high sample. Incremental loads were applied to the faces of the sample and the deflection was measured to 1/10,000 of an inch. Drainage of the sample during consolidation was through porous disks placed at each face. From the data collected, settlements under the anticipated loads could be calculated. The test results are presented on Plates 12 and 13.

Expansion tests were performed on representative samples. This test was performed on air-dried, in-place density and on remolded samples, using a 144 pound per square foot surcharge. Under these conditions, the results are as follows:

Test Pit No.	Depth (in feet)	Soil Description	Expansion (%)	Characteristics
5*	1.5'	CLAY, (CL/ML), red brown	2.7	moderate
7	2.5'	CLAY, (CH), dark brown	19.4	very high
25*	2.0'	CLAY, (CL), brown	12.7	very high

* Remolded and compacted to ninety (90) percent of the ASTM D - 1557 standard. Maximum density and optimum moisture was established following ASTM laboratory procedure D-1557. The results are presented on Plates 11, 14, 15 and 16.

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LOG OF TEST PITS

Test Pit #1

Depth (ft.)	Soil Description
0 - 1':	FILL: Clay, silty, red-brown, mod. firm, moist (CL)
1' - 2':	FILL: Clay, silty, grey&tan, mod. firm, moist (CL)
2' - 3.5':	Clay, silty, w/boulders, brown to dark grey brown, mod. firm mod. moist (CH/MH)
3.5'-4.5':	Clay, brown, mod. moist, mod. firm, (CL/CH)
4.5':	Basalt, weathered, grey

Bottom of Pit @ 4.5', No groundwater encountered

Test Pit #2

Depth (ft.)	Soil Description
0 - 3':	FILL: Clay w/boulders to 18", brown, sl. moist, loose (CL)
3' - 3.5':	Clay, silty, brown, sl. moist, mod. firm (CL)
3.5':	Basalt, weathered, grey

Bottom of Pit @ 3.5', No groundwater encountered

Test Pit #3

Depth (ft.)	Soil Description
0 - 1':	Clay, silty w/gravels, mod. firm, moist, dark brown (CL/CH)
1':	Basalt, weathered, grey

Bottom of Pit @ 1', No groundwater encountered

Test Pit #4

Depth (ft.)	Soil Description
0 - 2':	Clay, some silt, brown, mod. firm, mod. moist, (CL/CH)
2':	Basalt, weathered to highly weathered, grey and orange

Bottom of Pit @ 2', No groundwater encountered

Test Pit #5

Depth (ft.)	Soil Description
0 - 6':	Clay, silty, red brown, mod. firm to firm, mod. moist (CL/ML)
6':	Basalt, weathered, grey and orange

Bottom of Pit @ 6', No groundwater encountered

Test Pit #6

Depth (ft.)	Soil Description
0 - 3.5':	Clay, silty, red brown, mod. firm, mod. moist (CL/ML)
3.5':	Basalt, weathered, grey

Bottom of Pit @ 3.5', No groundwater encountered

LOG OF TEST PITS

Test Pit # 7

Depth (ft.)	Soil Description
0 - 2.5':	Clay, silty, red brown, moist, mod. firm (CL/ML)
2.5' - 4.5':	Clay, silty, dark red brown, moist, mod. firm (CH/MH)
4.5':	Basalt, weathered, grey and orange

Bottom of Pit @ 4.5', No groundwater encountered

Test Pit #8

Depth (ft.)	Soil Description
0 - 3':	Clay, silty, red brown, moist, mod. firm (CL/ML)
3' - 4':	Basalt, decomposed, orange brown and grey
4':	Basalt, weathered, grey

Bottom of Pit @ 4', No groundwater encountered

Test Pit #9

Depth (ft.)	Soil Description
0 - 3.5':	Clay, silty, red brown, mod. moist, mod. firm (CL/ML)
3.5'- 5':	Clay, silty, dark brown, moist, mod. firm, (CH/MH)
5':	Basalt, decomposed to highly weathered, grey

Bottom of Pit @ 5', No groundwater encountered

Test Pit #10

Depth (ft.)	Soil Description
0 - 2.5':	Clay, silty, red brown, mod. moist, mod. firm, (CL/ML)
2.5'- 3.5':	Clay, silty, brown, moist, mod. firm (CH/MH)
3.5'-4':	Basalt, decomposed, grey
4':	Basalt, weathered, grey

Bottom of Pit @ 4', No groundwater encountered

Test Pit # 11

Depth (ft.)	Soil Description
0 -1.5':	Clay, silty w/numerous boulders, brown, mod. moist, mod. firm (CH/MH)
1.5'-4':	Clay, silty , brown, moist, mod. firm, (CH/MH)
4':	Basalt, weathered, grey

Bottom of Pit @ 4', No groundwater encountered

LOG OF TEST PITS

Test Pit #12

Depth (ft.)	Soil Description
0':	Basalt, weathered grey (surface observation)

Test Pit #13

Depth (ft.)	Soil Description
0 - 2':	Clay, silty, brown, moist, mod. firm (CH/MH)
2':	Basalt, weathered, grey

Bottom of Pit @ 2', No groundwater encountered

Test Pit #14

Depth (ft.)	Soil Description
0 - 2':	Boulders, nested

Bottom of Pit @ 2', No groundwater encountered

Test Pit #15

Depth(ft.)	Soil Description
0 - 1.5':	Boulders to 18"
1.5'-3.5':	Clay, silty, dark brown, mod, firm, moist (CH/MH)
3.5'-4':	Basalt, decomposed, grey brown
4':	Basalt, weathered, grey

Bottom of Pit @ 4', No groundwater encountered

Test Pit #16

Depth (ft.)	Soil Description
0':	Basalt, weathered (surface observation)

Test Pit #17

Depth (ft.)	Soil Description
0 - 8":	Clay, brown, loose, mod. moist (CH)
8"- 2':	Clay, brown to dark brown, mod. firm, mod. moist (CH/MH)
2':	Basalt, weathered, grey

Bottom of Pit @ 2', No groundwater encountered

LOG OF TEST PITS

Test Pit # 18

Depth (ft.)	Soil Description
0 - 1':	FILL; Clay, brown, loose, mod. firm (CL)
1' - 2.5':	Clay w/boulders, dark brown, moist, mod. firm (CH/MH)
2.5'-3':	Basalt, decomposed, grey brown
3':	Basalt, weathered, grey

Bottom of Pit @ 3', No groundwater encountered

Test Pit #19

Depth (ft.)	Soil Description
0 - 1.5':	Clay, silty, some boulders, dark brown, mod. moist, mod. firm (CH/MH)
1.5':	Basalt, weathered, grey

Bottom of Pit @ 1.5', No groundwater encountered

Test Pit #20

Depth (ft.)	Soil Description
0 - 3':	Clay, silty, dark brown, mod. moist, mod. firm (CH/MH)
3' - 5':	Basalt, decomposed, orange and grey
5':	Basalt, weathered, grey

Bottom of Pit @ 5', No groundwater encountered

Test Pit #21

Depth (ft.)	Soil Description
0 - 1':	FILL; Clay, sandy, dark brown, mod. moist, mod. firm (CL)
1' - 3':	Clay, silty, numerous boulders to depth of 2', dark brown, moist mod. firm (CL/CH)
3':	Basalt, weathered, grey

Bottom of Pit @ 3', No groundwater encountered

Test Pit #22

Depth (ft.)	Soil Description
0 -1.5':	Clay, silty, dark brown, moist, mod. firm (CH)
1.5':	Basalt, weathered, orange-brown and grey

Bottom of Pit @ 1.5', No groundwater encountered

LOG OF TEST PITS

Test Pit #23

Depth (ft.)	Soil Description
0 - 2':	Clay, silty, dark brown, moist, mod. firm (CH)
2' - 2.5':	Basalt, decomposed, orange-brown
2.5':	Basalt, weathered, grey

Bottom of Pit @ 2.5', No groundwater encountered

Test Pit #24

Depth (ft.)	Soil Description
0 - 0.5':	Clay, brown, sl. moist, loose, (CL)
0.5'- 1':	Basalt, decomposed, orange-brown
1':	Basalt, weathered, grey

Bottom of Pit @1', No groundwater encountered

Test Pit # 25

Depth (ft.)	Soil Description
0 - 2':	Clay, silty, brown, moist, mod. firm, (CL)
2' - 4':	Clay, silty, dark brown, moist, very firm

Bottom of Pit @ 4', No groundwater encountered

Test Pit #26

Depth (ft.)	Soil Description
0 - 4':	Clay, silty, red brown, moist, mod. firm (CL/ML) boulders at 3' to 4'
4':	Basalt, weathered, grey-brown

Bottom of Pit @ 4', No groundwater encountered

Test Pit # 27

Depth (ft.)	Soil Description
0 - 1':	Clay, silty, red-brown, sl. moist, mod. firm (CL/ML)
1'-5':	Clay, silty, red-brown, moist, mod. firm (CL)
5':	Basalt, weathered, grey

Bottom of Pit @ 5', No groundwater encountered

Test Pit #28

Depth (ft.)	Soil Description
0 - 2.5':	Clay, silty, red-brown, moist, mod. firm (CL/ML)
2.5':	Basalt, weathered, grey

Bottom of Pit @ 2.5', No groundwater encountered

LOG OF TEST PIT

Test Pit # 29

Depth (ft.)	Soil Description
0 - 2.5':	Clay, silty, red-brown, moist, mod. firm (CL/ML)
2.5':	Basalt, weathered, grey

Bottom of Pit @ 2.5', No groundwater encountered

Test Pit # 30

Depth (ft.)	Soil Description
0 - 3.5':	Clay, silty, brown, mod. moist to moist, mod. firm; very firm below 1', (CH)

Bottom of Pit @ 3.5'

Test Pit #31

Depth (ft.)	Soil Description
0 - 1':	Boulders
1' - 3':	Clay, dark brown, moist, mod. firm (CH)
3' - 5':	Basalt, decomposed, orange-brown

Bottom of Pit @ 5', No groundwater encountered

Test Pit #32

Depth (ft.)	Soil Description
0 - 4':	FILL: Clay w/boulders and cobbles, brown, sl. moist, loose to slightly dense (CH)
4' - 5':	Clay, dark brown, moist, mod. firm (CH)
5':	Basalt, weathered, grey

Bottom of Pit @ 5', No groundwater encountered

Test Pit #33

Depth (ft.)	Soil Description
0 - 3':	FILL: Clay w/boulders and cobbles, brown to dark brown, moist loose to slightly firm, (CH)
3' - 6':	Clay, dark brown, moist, mod. firm (CH)
6' - 7':	Basalt, decomposed, orange-brown

Bottom of Pit @ 7', No groundwater encountered

LOG OF TEST PIT

Test Pit # 34

Depth (ft.)	Soil Description
0 - 2':	Clay, dark brown, moist, mod. firm (CH)
2' - 2.5':	Basalt, decomposed, orange-brown and brown
2.5':	Basalt, weathered, grey

Bottom of Pit @ 2.5', No groundwater encountered

Test Pit # 35

Depth (ft.)	Soil Description
0 - 1.5':	Clay, dark brown, moist, mod. firm (CH)
1.5'- 2':	Basalt, decomposed, orange-brown and brown
2':	Basalt, weathered, grey

Bottom of Pit @ 2', No groundwater encountered

Test Pit # 36

Depth (ft.)	Soil Description
0':	Basalt, weathered, grey (surface observation)

Test Pit # 37

Depth (ft.)	Soil Description
0 - 1.5':	Clay, dark brown, mod. moist, mod. firm (CH)
1.5'-3':	Basalt, decomposed, orange-brown and grey
3':	Basalt, weathered, grey

Bottom of Pit @ 3', No groundwater encountered

Test Pit # 38

Depth (ft.)	Soil Description
0 - 1':	Clay, dark brown w/boulders, mod. moist, mod. firm (CH)
1' - 2':	Basalt, decomposed, orange-brown and grey
2':	Basalt, weathered, grey

Bottom of Pit @ 2', No groundwater encountered

Test Pit # 39

Depth (ft.)	Soil Description
0 - 3':	Clay, brown, moist, mod. firm to firm, (CL/CH)
3' - 3.5':	Basalt, weathered, grey-brown (possible boulder)

Bottom of Pit @ 3.5', No groundwater encountered

LOG OF TEST PIT

Test Pit # 40

Depth (ft.)	Soil Description
0 - 1':	Boulders
1' - 1.5':	Clay, dark brown, moist, mod. firm (CH)
1.5'- 2':	Basalt, decomposed, orange-brown and grey
2':	Basalt, weathered

Bottom of Pit @ 2', No groundwater encountered

Test Pit # 41

Depth (ft.)	Soil Description
0 -4.5':	Clay, dark red-brown, moist, mod. firm (CL/CH)
4.5':	Basalt, weathered, orange-brown and grey

Bottom of Pit @ 4.5', No groundwater encountered

Test Pit # 42

Depth (ft.)	Soil Description
0 - 6':	Clay, red-brown, moist, mod. firm to firm (CL/ML)
6':	Basalt, highly weathered to weathered, grey and orange

Bottom of Pit @ 6', No groundwater encountered

SUMMARY OF LABORATORY TESTS

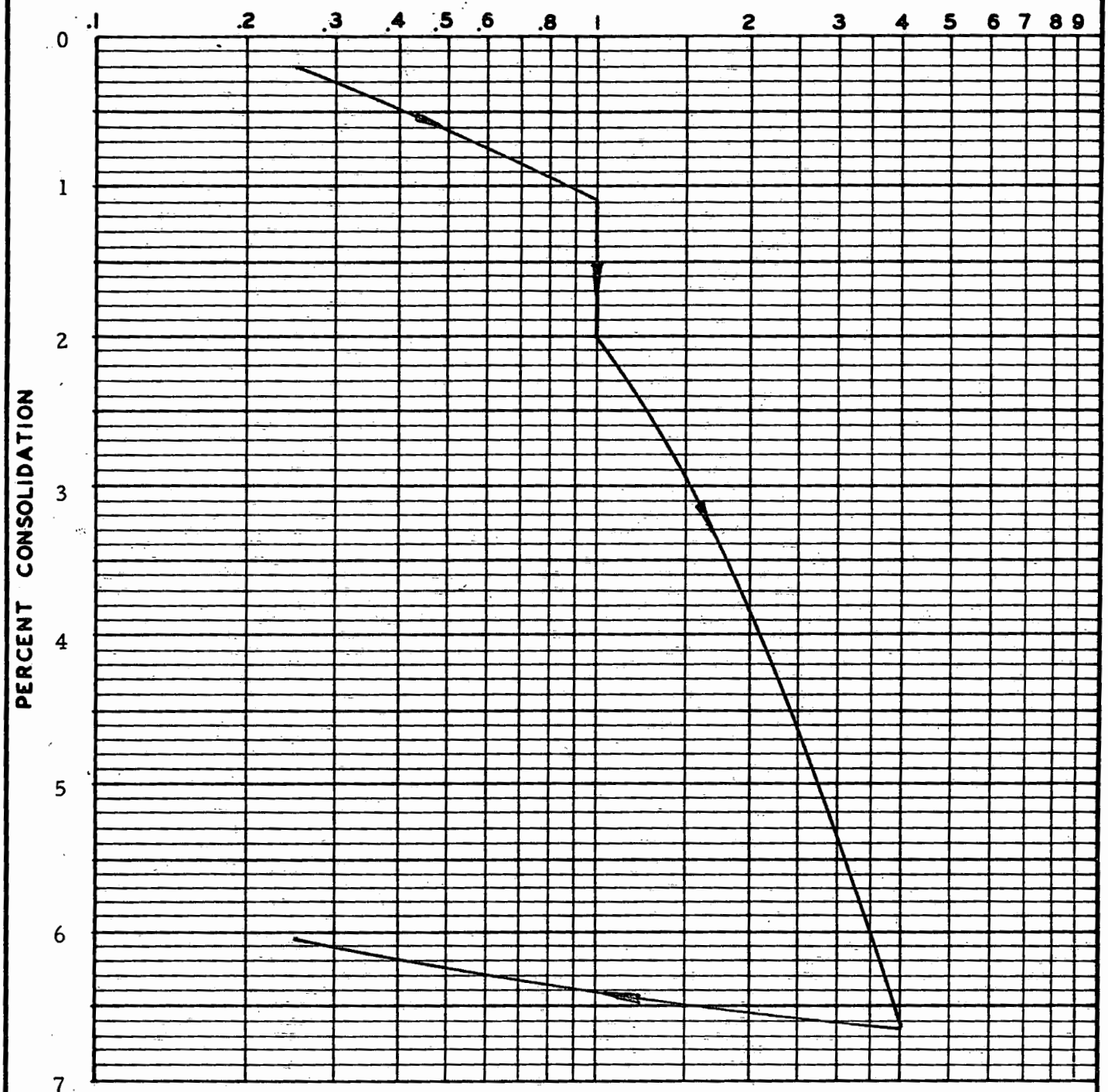
Test Pit No.	5	7	15	21	25
Sample No.					
Depth (ft.)	1.5'	4'	3.5'	2'	1'
Description	CL/ML red-brown	CH dark red-brown	SM orange brown & grey	CH brown to dark brown	CL brown
Density (pcf)					
Wet					
Moisture	19.7	29.2			
Dry					
Direct Shear@1000 psf					
Ult. (ksf)	1.56				2.54
Yield (ksf)	1.48				2.45
Atterburg Limit					
L. L.	37	66		58	42
P. L.	26	24		26	25
P. I.	11	42		32	17
Sieve Analysis(% passing)					
3"					
1"					
3/4"			100		
3/8"			82.6		
#4			73.7		
#10			63.1		
#20					
#40			48.6		
#60			46.5		
#100			43.6		
#200			43.1		
Compaction Test					
Max. Dry Density	107.0			107.0	111.0
Opt. Moisture	22.0			20.5	19.0
Expansion	2.7	19.4			12.7
C.B.R. Test					

KAPOLEI NEIGHBORHOOD, UNIT 6 | PLATE NO. 11

SOILS INTERNATIONAL | FILE NO. H-0073-F

CONSOLIDATION TEST DATA

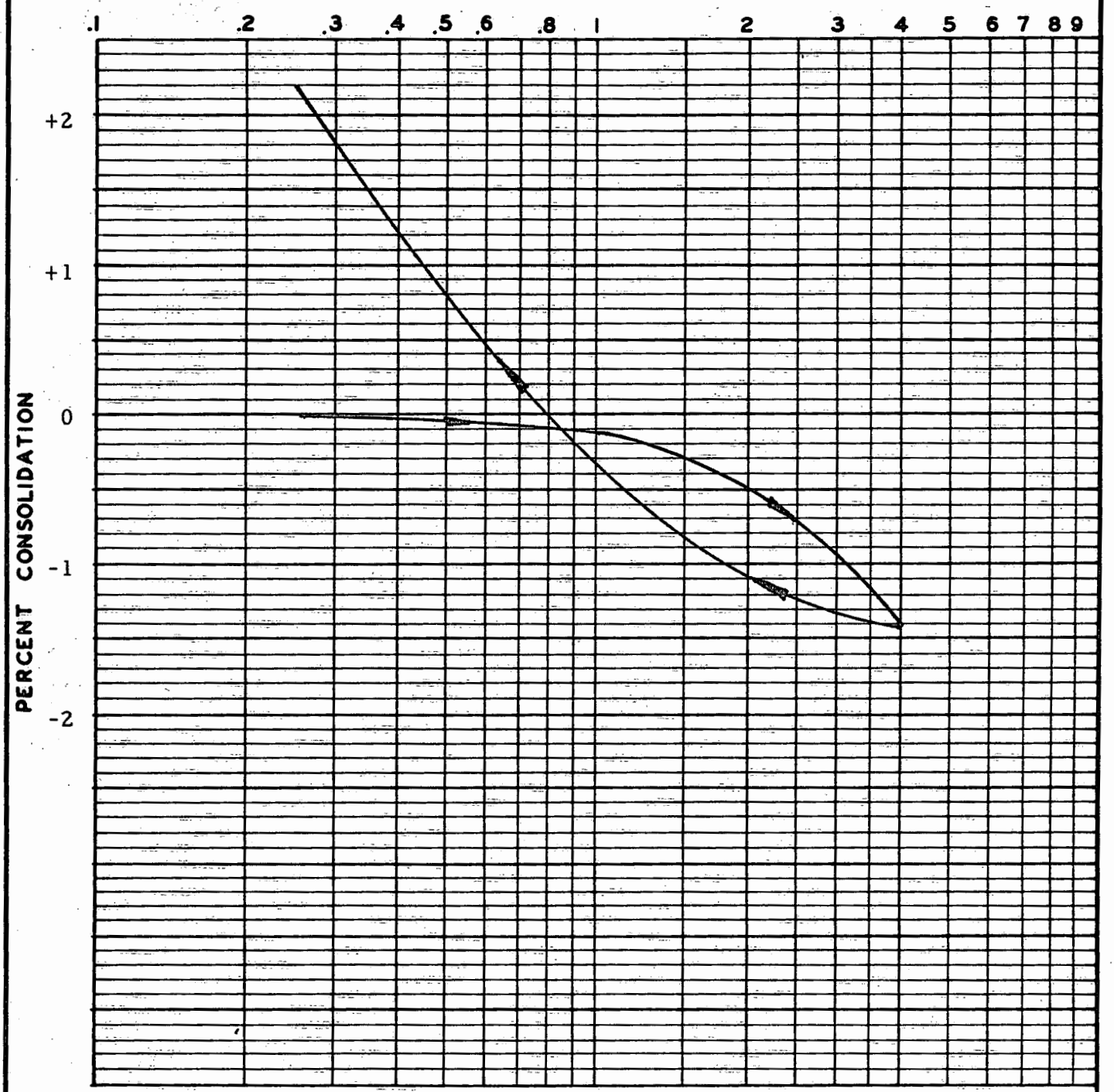
PRESSURE IN KIPS PER SQUARE FOOT



Water Added @ 1.0 ksf
Sample from Test Pit # 5 @ 1.5'

KAPOLEI NEIGHBORHOOD, UNIT 6	PLATE NO 12
SOILS INTERNATIONAL	FILE NO H-0073-F

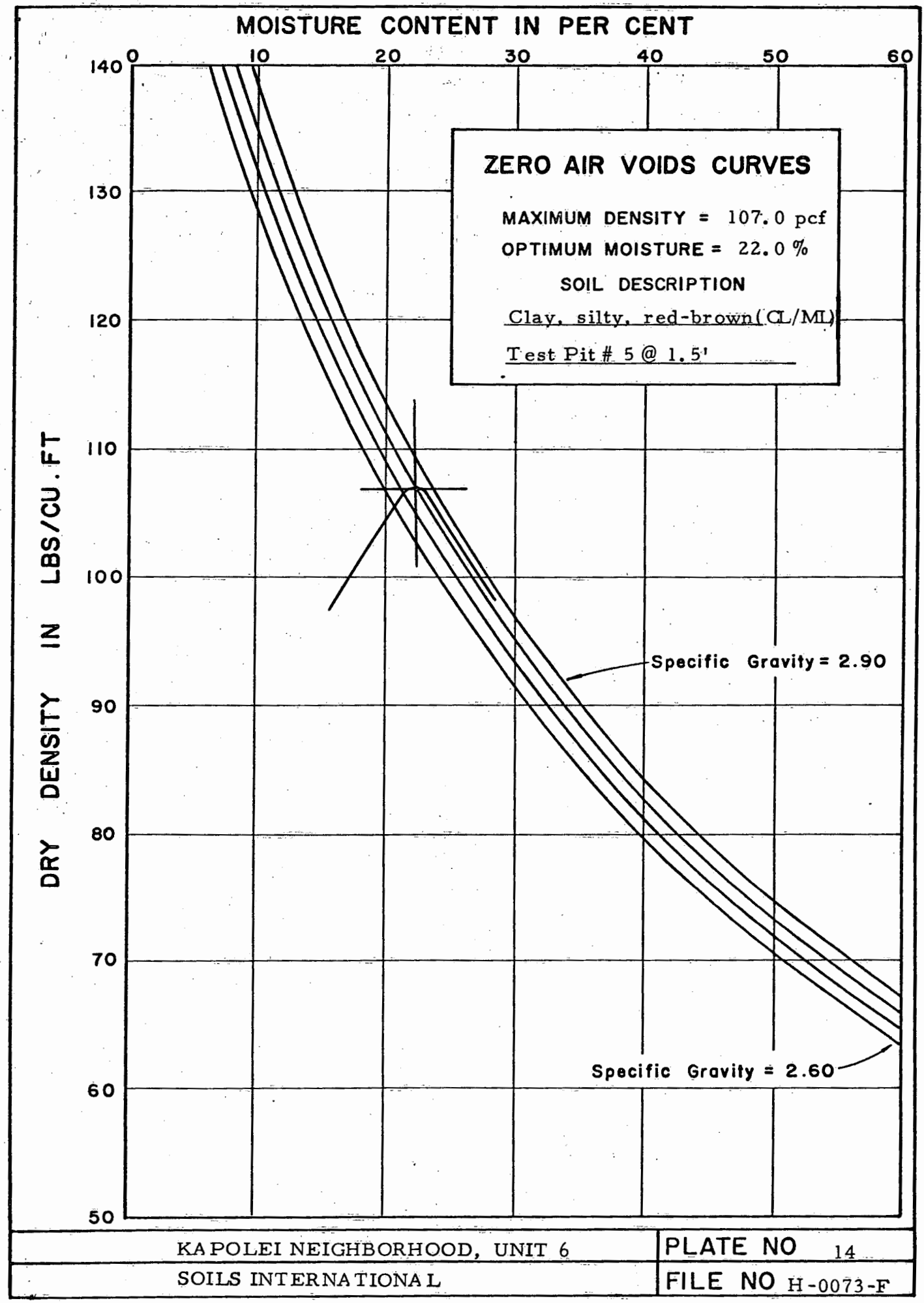
CONSOLIDATION TEST DATA



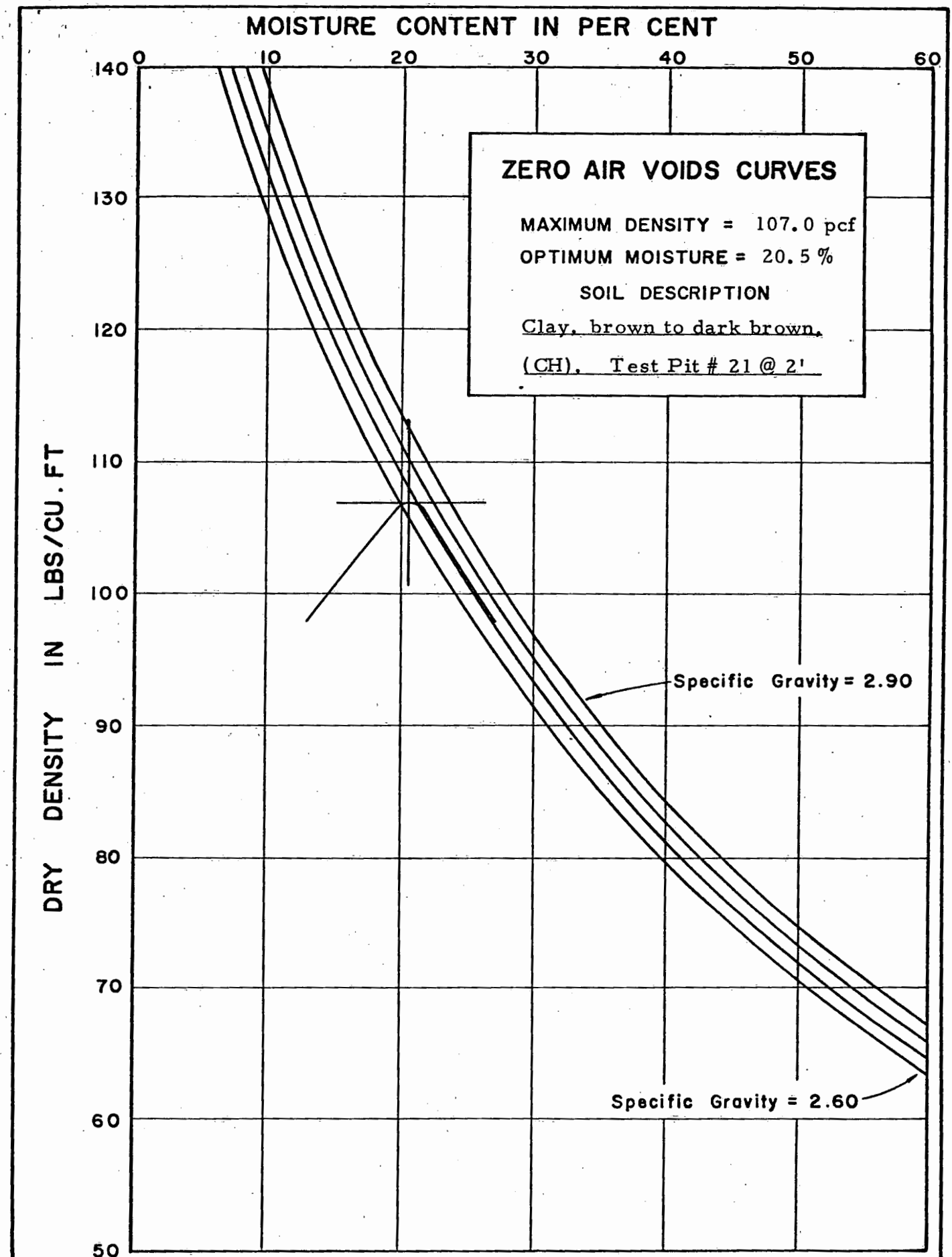
Water Added @ 1.0 ksf, sample restained from expanding until rebound

Sample from Test Pit # 7 @ 4'

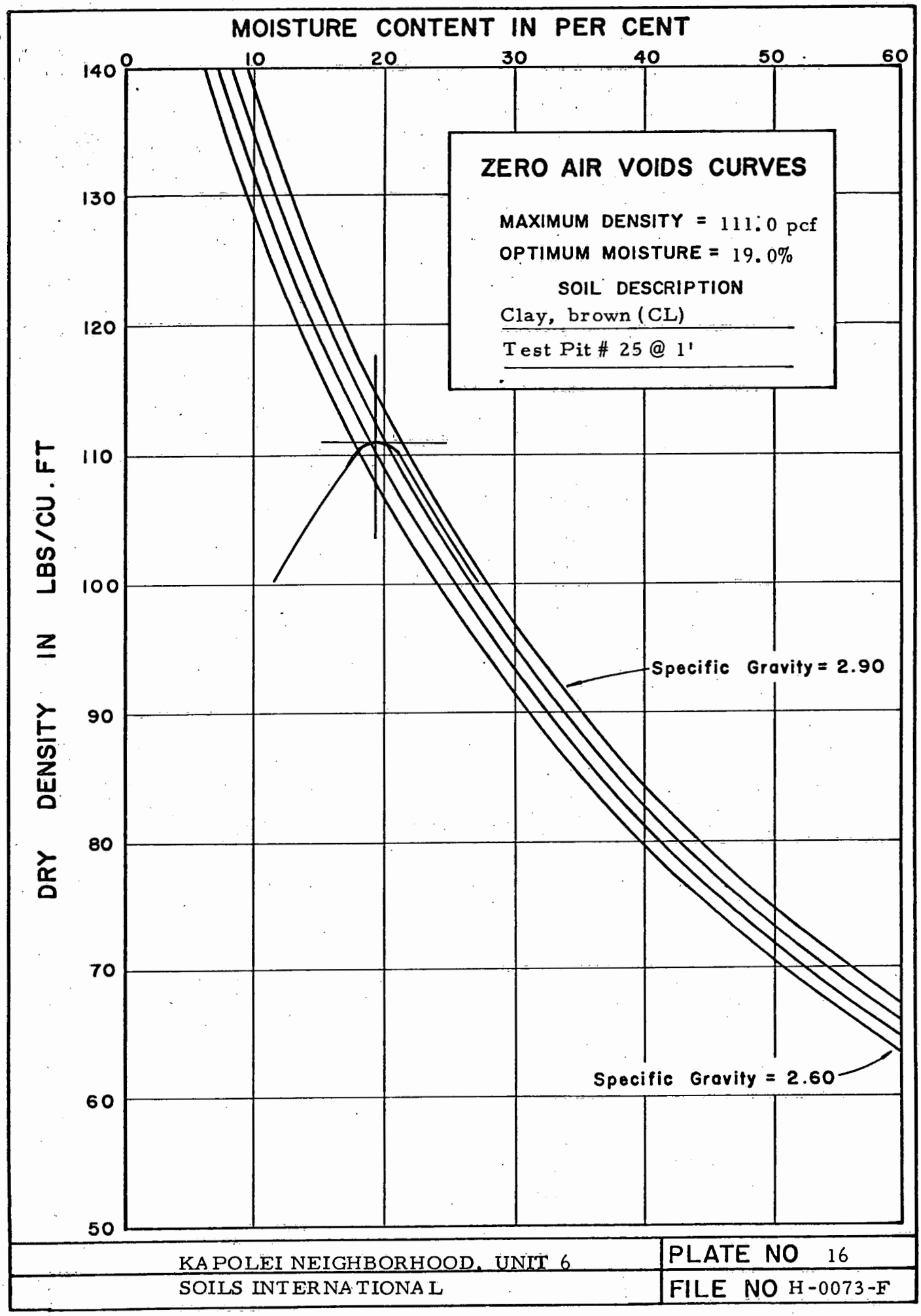
KAPOLEI NEIGHBORHOOD, UNIT 6	PLATE NO 13
SOIL INTERNATIONAL	FILE NO H-0073-F



KAPOLEI NEIGHBORHOOD, UNIT 6	PLATE NO 14
SOILS INTERNATIONAL	FILE NO H-0073-F



KAPOLEI NEIGHBORHOOD , UNIT 6	PLATE NO 15
SOILS INTERNATIONAL	FILE NO H-0073-F



KAPOLEI NEIGHBORHOOD, UNIT 6

SOILS INTERNATIONAL

PLATE NO 16

FILE NO H-0073-F

APPENDIX B

SPECIFICATION FOR CONTROLLED EARTHWORK

KAPOLEI NEIGHBORHOOD, UNIT 6

General

The designation "controlled earthwork" is applied to cuts and fills constructed and inspected by the Soils Engineer or his representative, who shall approve all foundation preparation, fill material, methods of placing and compaction and perform field density tests and inspection during grading. Written approval shall be issued upon completion of cuts and fills. No deviation from these specifications shall be made except upon the written approval of the Soils Engineer, the Federal Housing Administration and/or other public agencies having jurisdiction.

The Soils Engineer is to be a Civil Engineer, licensed in the State of Hawaii with knowledge of the application of soil mechanics in the investigation and analysis of the engineering properties of earth materials.

Clearing and Grubbing

All timber, logs, trees, brush, roots, grass, buried rubbish, large boulders, decayed matter, and other deleterious material within the areas affected by the grading shall be removed or otherwise disposed of in a satisfactory manner.

Foundation Preparation

Areas upon which fill is to be placed shall be uniformly scarified to a depth of at least six (6) inches until free of large clods, brought to the proper

moisture content and compacted until the density meets the requirements hereinafter specified. To permit an allowable bearing capacity of 2500 pounds per square foot and settlement of less than one-half (1/2) inch, all loose material shall be removed.

Loose material to be considered on this project includes any existing fill, soil disturbed by the clearing and grubbing operations and any porous natural soil in the building areas. The loose material may be re-used as fill, provided that it meets the requirements for fill material as specified herein.

Very highly expansive soils encountered under slabs shall be removed to a depth of at least thirty-six (36) inches below subgrade and be replaced with non-expansive soil. Subgrade soils under slabs with moderately expansive characteristics shall be removed to a depth of twenty-four (24) inches and replaced with non-expanisve soils. As an alternate, the in-place moderately expansive soils could be presaturated to a moisture content of at least three (3) percent above optimum moisture for a depth of at least twenty-four (24) inches.

If lava tubes or voids in the basalt are encountered during grading, they shall be opened, cleaned of all loose or deleterious material and backfilled with clean gravel.

Fill Material

When the material to be used as fill contains large rocks or hard, cemented lumps that cannot be broken readily, such material shall be placed in open,

non-structural fill areas or shall be removed from the site. All large boulders, which cannot be broken down to a maximum diameter of six (6) inches, shall be removed or stockpiled for use other than as an engineered fill. If placed in open areas, the boulders shall be well distributed throughout the fill and surrounded by sufficient fine soil so as to fill the interstices and produce a dense fill without voids. No rocks over three (3) inches in greatest diameter shall be used in the upper one (1) foot of fill. Jetting will not be permitted. All material to be used as fill shall be approved for the purpose by the Soils Engineer.

Compaction Requirements

All fill shall be placed in uniform layers not exceeding eight (8) inches in loose thickness. Each layer shall be thoroughly compacted completely to the edge before the next layer is laid thereon. Compaction shall be obtained with the use of conventional equipment designed for the purpose. The incidental compaction achieved by the passage of hauling units over the fill will not be considered adequate.

Each layer of soil shall be brought to a moisture content sufficiently close to "optimum moisture" to permit the required degree of compaction, the "optimum moisture" being determined by ASTM D - 1557. If the soil's moisture content is too high or too low, it shall be adjusted by suitable means before placing. Compaction of each layer of fill, including slopes,

berms, etc., shall be continued until the density as determined by field tests reaches a value of at least ninety (90) percent of the maximum indicated by the aforementioned methods. In lieu of compacting the slopes, the embankments may be overfilled and then cut back to adequately compacted material.

Where fill supports structural loads, the material shall be compacted to at least ninety (90) percent of the maximum dry density. The fill shall extend beyond the footings a distance of at least five (5) feet, or the depth of fill beneath the footings, whichever is greater.

In all cases where the ground slope is steeper than five (5) horizontal to one (1) vertical, the existing slope shall be keyed when fill is placed on the slope. Any existing ground slope flatter than five (5) to one (1) shall also be benched if the Soils Engineer considers such to be necessary.

Cuts

All cuts shall be made to the lines and grades as shown on the project plans. All cuts shall be inspected and approved by the Soils Engineer. Where conditions encountered require he shall direct the necessary modifications to be made.

Drainage

Care shall be exercised during grading so that areas envolved will drain properly. Water shall be prevented from running over the slopes by temporary berms.

Field Testing

The Soils Engineer shall be notified at least two (2) days prior to the start of grading. A pre-grading conference shall be held between the parties involved so as to discuss methods of operation, site problems and scheduling. Field density tests shall be made by the Soils Engineer, subject to the approval of all agencies having jurisdiction. When tests or inspection indicate that the density or uniformity of any portion of the fill is inadequate, that particular portion shall be removed and reworked until the required density has been satisfactorily obtained.

Prior to pouring building slabs, pre-saturation tests shall be made in areas where pre-saturation is required.

Supervision

At all times the Contractor shall have a responsible field superintendent on the project in full charge of the work with authority to make decisions. He shall cooperate with the Soils Engineer in carrying out the work. Any instructions given to him by the Soils Engineer, or his duly appointed representative, shall be considered to have been given to the Contractor personally.

Rainy Weather

No fill shall be placed, spread or rolled during unfavorable weather. When the work is interrupted by rain, operations shall not be resumed until field tests by the Soils Engineer indicate that conditions will permit satisfactory results.